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Douglas-fir Beetle

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The Douglas-fir beetle (*Dendroctonus pseudotsugae* Hopk.) infests Douglas-fir throughout most of the range of that tree in Western United States, British Columbia, and Mexico. The beetle also produces broods in felled western larch but is unable to produce broods in living larch.

Douglas-fir beetles normally kill small groups of trees, but loss can be devastating during periodic outbreaks such as four that occurred in western Oregon and Washington from 1950 through 1969, during which 7.4 billion board feet of timber were killed. Between those outbreaks, annual losses averaged 10 million board feet. Other western forests have suffered similarly severe Douglas-fir mortality caused by the beetle. For example, in 1966 an outbreak in California killed 800 million board feet of timber and an outbreak in Idaho killed 109 million board feet of Douglas-fir between 1970 and 1973.

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Douglas-fir beetle infestations usually occur in trees damaged by windfalls, fire-scorch, or defoliation. Where susceptible trees are abundant, the beetle population can build up rapidly and spread to adjacent green timber. Damage is greatest in dense stands of mature Douglas-fir. Host tree susceptibility to attack is correlated with drought and root disease. Various fungi introduced by the beetles also contribute to mortality of infested trees.

External Evidence of Infestation

Reddish-orange frass consisting of fragments of phloem (inner bark) expelled from bark crevices by invading beetles is the first

sign that a tree has been attacked. Because wind and rain remove the frass, and because attacks are sometimes above reach, a tree must be examined carefully to determine if the beetles are present. Sometimes the most evident sign of infestation is clear resin exuding from entrance holes on the stem at the upper limit of the infestation (fig. 1).

Several months after the tree is infested, its foliage becomes discolored (fig. 2). First, the needles turn yellow, then sorrel, and finally, reddish brown. Although some trees are discolored as early as August, others may remain green until the following June. The time of year that this discoloration becomes visible varies with locality, date and intensity of infestation, elevation, and seasonal weather. Needles are shed and conks of the pouch fungus, *Cryptoporus volvatus* (Pk.) Hubbard, form on the outer bark during the year following infestation.



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Figure 1.—Beetle attacks cause pitch to exude from the uppermost infested portion of the tree.

Description of Life Stages

Adult Douglas-fir beetles are stout, somewhat cylindrical in cross section, and 4 to 6 mm long (fig. 3). The head and thorax are black, whereas the wing covers are usually reddish brown, becoming darker with age. The whitish eggs are 1 mm long. Eggs hatch into white, legless larvae with shiny, light-brown heads (fig. 4). Mature larvae transform into a brief pupal stage before becoming adults. Pupae are white, mummy-like, and have some adult features, including wings that are folded beneath the abdomen (fig. 5).

Seasonal History

The Douglas-fir beetle has one generation per year. Broods remain in the tree and overwinter mainly as adult beetles, but also as larvae. Depending on variations in locality and seasonal weather, adults that have over-



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Figure 2.—Group of trees killed by Douglas-fir beetles.



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Figure 3.—Adult Douglas-fir beetles and eggs.



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Figure 4.—Douglas-fir beetle larvae.

wintered generally emerge and fly to new host trees from April to early June. Larvae that have overwintered complete their development and emerge in the summer. Some adults that flew in the spring reemerge and make a second attack usually in late June and July.

Galleries and Characteristics of Infestation

The distinctive egg galleries (see cover) are constructed by the female beetles which bore through the bark and tunnel upward in the phloem, lightly engraving the sapwood. Galleries run parallel to the wood grain, commonly for lengths of 8 to 10 inches (20.3 to 25.4 cm); they are somewhat longer in windthrown trees. Galleries are packed with frass except at the top where the beetles are actively working. The females lay eggs alternately along opposite sides of the galleries as construction progresses. The eggs hatch in

1 to 3 weeks; the newly hatched larvae mine outward from the egg gallery in the phloem. These mines are visible on the inner surface of the phloem and increase in width as larvae molt and grow through four stages. During the final stage of growth, larvae construct pupal cells at the ends of their mines (fig. 5).

Tree stems are infested for varying lengths, but seldom higher than a top diameter of 6 or 8 inches (15.2 or 20.3 cm). Other bark beetles, *Scolytus tsugae* (Swain) and *Pseudohylesinus nebulosus* (LeConte), often occur in the top of the stem. In standing trees, Douglas-fir beetle egg galleries are usually more dense and the brood survival higher in the middle portion of the infested stem. In windthrown trees, egg galleries tend to be uniformly successful, but are generally more dense on the shaded underside. Douglas-fir beetles usually construct from 5 to 12 egg galleries



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Figure 5.—Douglas-fir beetle pupae.

per square foot (929 cm²) in standing trees, but only 2 to 6 galleries per square foot in wind-thrown trees.

Control

The resistance of live trees to bark beetle attack is the most important natural control factor. Climate and weather also strongly influence Douglas-fir beetle populations. Natural enemies include many parasitic or predacious insects, nematodes, and mites. Woodpeckers are not important predators of the beetle.

It has not been economically feasible to suppress Douglas-fir beetle outbreaks. During tests, broods in felled trees have been destroyed by sprays that fumigate the galleries. Similarly, insecticides that kill by contact have reduced attacks in test logs. Because felled trees are usually attacked less densely than are standing trees, the felled trap-tree method of control is inefficient.

Several pheromones—secretions that influence mating and aggregation—have been identified from the Douglas-fir beetle. When certain pheromones (frontalin or seuadenol) are placed on live Douglas-firs or combined with volatile components of Douglas-fir-resin, flying beetles are attracted to the trees. Another pheromone (methylcyclohexenone) disrupts attraction. In nature, these pheromones serve to attract Douglas-fir beetles, helping them concentrate their numbers to overcome resistance of trees, and then to terminate attraction after mating has taken place. The potential usefulness of synthetic pheromones in surveying and managing beetle population is under study.

Management of Douglas-fir forests offers the best method of preventing or minimizing damage by the Douglas-fir beetle. Stands that are mature or overmature should be harvested. Younger stands should be thinned periodically to maintain vigorous growth and to reduce moisture stress. Such practices should be accompanied by salvage of windthrown or infested trees before beetle broods emerge from them.

Reference

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